RE: questions for PA[illegible]

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Reply Reply to All Forward

710-P

From: Bhol, Saroj [sbhol@panynj.gov] Sent: Fri 1/30/2004 10:11 AM

To: 'Shyam Sunder'

Cc: ddevans@nist.gov; cauffman@nist.gov; cheri.sawyer@nist.gov; john.eichner@nist.gov; wgrosshandler@nist.gov; Begley, James; Fadavi, Ali; Lin, C. John; Lombardi, Frank; Reiss, Alan

Subject: RE: questions for PANYNJ

Attachments: Questions for PANYNJ1.doc (50 KB)

Shyam,
Please see the attachment for response.
Thanks
Saroj
-----Original Message-----
From: Shyam Sunder [mailto:sunder@nist.gov]
Sent: Tuesday, January 20, 2004 12:02 PM
To: Bhol, Saroj
Cc: ddevans@nist.gov; cauffman@nist.gov; cheri.sawyer@nist.gov; john.eichner@nist.gov; wgrosshandler@nist.gov
Subject: Fwd: questions for PANYNJ

Saroj,

Project 4 of the WTC investigation on Active Fire Protection Systems has a number of questions that it would like answered. Could you please respond to the attached questions in the near future? Thanks.

Shyam

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X-Sieve: CMU Sieve 2.2
X-Sender: ddevans@mailserver3.nist.gov
X-Mailer: QUALCOMM Windows Eudora Version 5.1
Date: Tue, 20 Jan 2004 10:17:17 -0500
To: sunder@nist.gov
From: Dave Evans <dave.evans@nist.gov>

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Questions for PANYNJ –
Note: PANYNJ responses are in red, italics, and underlined.

Sprinkler System:
The WTC complex had been net leased to Silverstein properties and on 9/11, all contractors at the complex worked for Silverstien and not the PANYNJ.

General

1. Who was performing the inspection, testing and maintenance of the sprinkler systems? Standpipe systems? Fire pumps? Water tanks and valves? *All by American Building Maintenance (ABM).*
2. Are copies of the inspection, testing and maintenance reports available from the contractor (or PANYNJ) or were copies stored at a secondary PANYNJ location, which are available? *No copies were stored off site.*
3. Are any photographs (paper or electronic) available for any of the fire sprinkler systems, standpipe systems, fire pumps, water storage tanks, valves or any other related equipment in WTC 1, 2 or 7? *Orange O&M Manuals, previously provided to NIST, have pictures and details of WTC 1 & 2. WTC 7 was fully operated by Silverstein properties and this question should be addressed to them.*
4. Were there any locations where standpipe or sprinkler system piping was routed through areas or floor levels that were not provided with automatic sprinkler coverage (i.e. without a sprinkler system in the area)? Was the sprinkler or standpipe system piping (or related equipment) protected in these areas? Were the pipes encased in fire resistive materials? Were soffits or pipe chases constructed? *Standpipe and sprinkler lines ran through MER areas that were not sprinklered. However, Air Handling Units in these rooms were equipped with deluge sprinklers. Pipes through MER were not protected or insulated but sprinkler lines within 10 feet of outside perimeter were insulated to protect against freeze-ups.*
5. How many maintenance personnel were available in each building (WTC 1 and 2) on 9-11-01 that were familiar with emergency operations regarding the fire suppression systems? For instance, isolating valves or operating pumps? *About 15 ABM personnel plus a few PA mechanical supervisors.*
6. How were the tank water levels maintained and monitored? Visual level indicators, pressure switches, float switches? Were water levels monitored at a centralized location? *Automatic fill utilizing float valves. There were Hi/Low flow alarms that were monitored.*
7. How were the water tanks filled? Manually or automatically? If manual fill only, were emergency procedures in place to open the tank fill valves during fire department operations? *Automatically but there was a manual by-pass to fill tanks during fire pump capacity test and /or fire dept. operations.*
8. How were the manual fire pumps started? *Sprinkler pumps worked on pressure switches; standpipe pumps were started manually with controls by pumps.* Where were the manual fire pump controllers located? *By the pumps, i.e., B1 level, 7, 41, 75 etc.* Who operated the pumps, the PANYNJ or the FDNY? *The pumps were operated by ABM engineering staff.*

9. Were there any renovations undergoing construction on 9-11-01 that required shut down of the sprinkler systems or portions of floor levels? *Unknown. Typically Fire Safety Director at lobby Fire Command Desk would issue burning permits and make sure adjacent floor sprinkler systems were not shut down during tenant alterations.*

10. Were all of the fire sprinkler systems active at the time of the impact on 9-11-01? *Unknown, they should have been active.* Standpipe systems? *Unknown, but no notification was received that any were o/s.* Fire pumps? *Unknown, but no notification was received that any were o/s .* Water tanks, valves and other related equipment? *Unknown, but no notification was received that any were o/s*

WTC 1&2

11. Were the core areas on the mechanical, electrical equipment floors provided with automatic sprinkler systems? *NO*

12. Were the mechanical, electrical equipment floors provided with automatic fire sprinkler systems throughout? *NO, only the fan chambers had internal sprinkler systems*

13. Were all of the mechanical floors 2-stories in height? Please describe. *Yes, above grade, fire pump room on B1 was only single story.*

14. Were floor levels 108, 109 or 110 provided with partial or complete sprinkler systems? *108/109 had fans with internal sprinklers and 110 had sprinklers or halon gas systems for TV broadcasters leaseholds.*

15. Were any of the valves electronically controlled (solenoid type)? *Fans had deluge system besides quartz bulb sprinklers. Fan deluge vale activated based on cross-zoned smoke detectors.* Were these valves operated from a centralized control location? No Where was the control center? n/a

WTC 1- *No definite information - ABM mechanical engineering staff like Vito Delao and Dave Williams were killed while operating systems and rescuing people.*

16. What was the extent of the damage to the sprinkler and standpipe system after the impact to WTC 1? *Some observers reported water cascading down from the ceiling in 1 WTC lobby almost immediately after impact indicating that water lines had been ruptured.*

17. Were any risers damaged or destroyed?

18. What emergency procedures were implemented to minimize water loss from pipe breaks associated with the impact?

19. Was anything done to isolate the risers or do emergency procedure take place to isolate the risers?

20. Which valves were isolated? Which fire pumps were manually operated?

WTC 2- *No definite information*

21. What was the extent of the damage to the sprinkler and standpipe system after the impact to WTC 2?

22. Were any risers damaged or destroyed?

23. What emergency procedures were implemented to minimize water loss from pipe breaks associated with the impact?
24. Was anything done to isolate the risers or do emergency procedure take place to isolate the risers?
25. Which valves were isolated? Which fire pumps were manually operated?

FIRE ALARM SYSTEM

System Upgrade

1. After the 1993 bombing, numerous fire alarm improvements were initiated including the replacement of the existing fire alarm system. Survivability of system functions were included into the replacement system criteria. Were there any standards used in the development of the system specifications and installation criteria beyond the experience gained from the 1993 bombing? *Latest NYC Bldg Code Ref standards, latest NFPA 72 not yet adopted, discussions and meeting with FDNY staff both technical and chiefs.*

2. Do you have a riser of the fire alarm equipment layout as originally installed in WTC 1 and 2? *This is in one of the orange manuals. The old system was computer based with an executone public address/intercom system.* Do you have a bill-of-material for the original fire alarm purchase? *No.* Do you have any design drawings or documentation on the original configuration of the Phase II and Phase III fire alarm project device layouts as the phases were described in the Joseph Mizrahi, P.E. paper (date unknown) "The World Trade Center Fire Alarm System Before and After"? *Yes, Previously provided to NIST.*

3. Do you have any WTC 1 and 2 fire alarm record design drawings or documentation that provides:

a. Location of the Fire Command Stations and Remote Command Stations. *Yes, see #2. The fire command stations (FCS) were in the lobbies. Each had a redundant panel in a remote location and each had a panel in the Operation Control center on the B1 level of tower2.*

b. Configuration of the fire alarm panels at the Fire Command Centers. *Yes, see #2. Each FCS had electronic control panels mounted on the wall for alarm transmission, public address communications, and verbal communication with individual floor warden telephones.*

c. Listing of audible notification zones for each system. *Yes, see #2*

d. Location of the various transponders, terminal cabinets, and interface points. *Yes, see #2*

e. WTC1 and 2 fire alarm device layouts for each floor. *See #2*

f. Sequence of operation narrative and/or input/output matrix showing the fire alarm system functions. *See #2*

g. Copy of the fire alarm software program for the fire alarm systems in WTC 1 and 2. *Backup copies were in safes at WTC, best to ask Cerbes Pyrotronics if they have. They did configuration of the system as devices were added etc.*

System Testing and Maintenance

4. The features of the post 1993 fire alarm system design provided communication and notification capabilities that were integral to the "World Trade Center Fire Safety Plan"? Were fire drills preformed every six months as planned? *Yes, see videos supplied to NIST. Occupant fire drills were conducted semi-annually, at a minimum.* Was there lesson learned documentation on the performance of the fire alarm system in relation to the fire drills? *Critique meetings were held after every drill with members of the tenant fire safety teams to review alarm audibility, among other things.* Were there changes to the fire alarm system based upon lesson learned from the fire drills? *At times, modifications to the fire alarm system would be made based on feedback obtained during the critique meetings.*

h. Was there ever a full evacuation of either tower based upon a fire spreading to multiple floors? *No, normally a zone would be evacuated but not entire tower.* Was there ever a full evacuation of either tower based upon any fire scenario? *NO, but there were during blackouts, like that from the south street seaport substation fire.* If so, how did the capabilities of the fire alarm system function during a full evacuation drill? *This was pre 93, and executone public address system worked fine.*

i. Was it a normal occurrence to have sections of the fire alarm coverage disabled due to testing or maintenance? *No, automatic alert tone might be disabled on a floor during testing.* During 9/11, was any part of the system disabled due to maintenance or repairs? *Unknown*. If so, which portion of the system was disabled? Did this have an impact on the overall effectiveness of the system functions during 9/11? *Maintenance on the fire alarm system occurred periodically. Any part of the system taken off-line was kept to a minimum and was documented and as well notifications made to FDNY, among others. There is no information that any maintenance was being performed on 9/11/01.*

Remote Monitoring Indications and Actions

5. Where were the locations of all the remote monitoring and control stations for WTC1, 2, and 7 fire alarm systems? *WTC 1 & 2 had remote monitoring at OCC*

on B1 level of 2 WTC. In addition, 2 WTC could be monitored in 1 WTC. See 3a. For 7WTC, contact Silverstein. Did any of the locations for each fire alarm system have more or less monitoring and control capabilities than other locations? *The PA installed upgrade had same capabilities, i.e. Redundant electronics with panels in OCC.* In your opinion, were there certain locations more helpful than others? Were there locations with limited capabilities would of performed better with enhanced capabilities?

a. In your opinion, did the fire alarm graphic enunciator at the WTC 1 and WTC 2 Fire Command Centers, and their redundant graphic enunciator at the Operations Command Center, provide timely information in relation to the occurrence of the fire events on 9/11? Overall, was the information useful for decision making? If yes, what was most useful? If not, what was not useful? *Using Tower 1 as an example, the events of 9/11 necessitated an immediate and total evacuation. The graphic annunciator was of little to no use, given the overwhelming situation.*

b. Were you able to determine which floors, and/or areas were experiencing a fire emergency with the graphic annunciator? Was this determination done quickly through an analysis of the information provided by the fire alarm equipment? Did the Port Authority Fire Brigade respond to the event based upon the fire alarm information? Was the information relevant to the events or was there information annunciated that you would consider excessive? *No, the graphic annicIator was not used. The response by the fire brigade and others was based primarily on visual observations and radio communications.*

c. Were the annunciators overloaded with communication faults, troubles and other information not directly related to life safety and general egress? If they were causing screen overload, would the display of alarm information only aid in determining the extent of the damage as well as allow a better understanding proper egress messages? *See 5a.*

d. Were you able to determine if the fire alarm system was functional above the impact floors? If so, what functions of the fire alarm system remained operational? *No.*

e. Were you able to determine the growth of the fire through the display of new alarms? If so, which areas first provided a fire alarm signal and which areas followed in sequence? *No*

f. The fire detection and alarm system was programmed to automatically initiate numerous functions upon an alarm event. Is it your impression that the system function as designed? *Yes.* If not so, which functions did not occur?

g. Specifically, were there indications that the return air smoke detectors in the vicinity of the "fire floor" automatically shut down all return and supply air-fans serving the "fire floor" areas? *Unknown.* Were elevators recalled to the primary recall floors? Were fire doors closed automatically? *Some elevators were observed "parked" in the lobby, as they would be during a recall operation.*

h. The fire detection and alarm system was programmed to automatically initiate numerous functions upon an alarm event. Is it your impression that the system function as designed? If not so, which functions did not occur?

i. Specifically, were there indications that the return air smoke detectors in the vicinity of the "fire floor" automatically shut down all return and supply air-fans serving the "fire floor" areas?

j. Specifically, was notification alarms activated on the "fire floor" and the floor above? *Yes.*

k. Specifically, were elevators recalled? *See 5g.*

Initiation Device Performance

6. The fire alarm system had a minimum of one manual station located on each floor above the Concourse level. Were any stations activated during the event? *Yes, manual devices were activated. The exact number cannot be recalled.* Did the activation of any fire alarm manual station provide information before the same information was received by the supervising station from other means? In your opinion, was there an excess amount of manual stations activated during the event? *The upgraded system had a manual station at each exit door into the fire stairs; in the towers this would have been 3 per floor.*

Occupant Voice/Alarm Notification

7. The fire alarm system was programmed to provide automatic occupant notification to the "fire floor" and the floor above. Were you able to tell if the system functioned as programmed? *The fire alarm system was not programmed to automatically broadcast a signal to the fire floor and floor above. These parameters were set manually by the FSD based on the circumstances. On 9/11, the system was immediately configured to broadcast alarms/public address to the entire tower(s)*

a. In your opinion. did the fire alarm system provide the building occupants with useful information that enhanced their chance of survival? Was the content of the information not relevant or confusing? Was relevant information provided to the correct locations in a timely fashion? What could be improved?

b. It is our understanding that there was a intercom system located in the same cabinet with the manual stations with direct communication to the Operations Control Center. *This was part of the old executone pre 93 fire alarm system. This was removed when the new pyrotronics MXLV was installed. There was one warden phone per floor in cross-corridor & then a separate manual pull station at each stairwell entrance door.* Was this capability used during the event? Was the presence of this communication capability for use by untrained occupants helpful or a hindrance? Since the system was not ULI listed as a fire alarm system component, it would not have the built-in survivability characteristics associated with a fire alarm communication system. Was it noted that the intercom capability failed in certain areas while the fire alarm functions remained in operation? *This system was removed from service when new fire alarm installed.*

Warden/Fireman Communication

8. Were there conflicts or confusion with communicating with the Floor Wardens during the fire emergency? Were the Warden notification procedures followed during the emergency? Did the fire alarm communication capability function as expected during the fire event or was the fire alarm system overwhelmed? *No conflicts with floor wardens or others were reported. The fire alarm system appeared to function normally and as designed.*

SMOKE MANAGEMENT

1. In the 1996 Hughes report titled, "Smoke Management Evaluation Study of The World Trade Center Complex Excluding the Concourse and Plaza" the following recommendations were made:
    a. Entire Complex Sprinkler Protection- *Done*
    b. Emergency Smoke Management Sequence in Tower Buildings, including:
        i. Notify the NY City Fire Department and follow the WTC emergency procedures for the floor involved and adjacent floors. *Normal SOP*
        ii. Upon activation of any smoke detector or sprinkler system, set the HVAC system covering the entire zone where the fire is detected to core pressurization. *Not done.*

NYC code & FDNY wanted all fan shutdown & fans to be activated only at direction of on scene chief.

iii. If smoke detectors involving 2 or more detectors on floors other than the fire floor occurs, evacuate all floors served by the MER serving the fire floor that are on the same side of the MER floor as the fire floor; that is all floors served by the same supply fans that serve the floor of fire involvement.

c. Handling An Uncontrolled Fire in a Tower - It is prudent to provide contingency plans for smoke protected egress and refuge in case of such an event occurs. Plans to institute positive pressure ventilation should be developed and coordinated with the New York City Fire – *FDNY wanted full fan shutdown as plans for new fire alarm system were reviewed and discussed with their technical staff.*

d. Path Terminal - The Port Authority needs to continue its studies of smoke management in the PATH terminal. A minor, sprinkler controlled fire in the terminal would not present a serious hazard. A major fire, typified by a PATH car fire could, however, expel smoke into the Concourse, migrating either into the towers or into 5 WTC. The smoke could be held back by shutting down all Concourse return fans and sufficient return fans in the towers so that air flow is from the tower lobbies into the Concourse. If this were done, however, the smoke would be forced into the terminal and the PATH system itself. We understand that Port Authority Engineering has completed a preliminary design for the PATH Terminal smoke management system that is compatible with the criteria, assumptions, and findings of this study. *PATH installed new smoke control/exhaust fans at WTC at top of station that routed exhaust out North projection of WTC on west st. Smoke Barrier was also to be installed at ceiling over the path mezzanine.*

e. Interrelationship of PATH Terminal and Complex - It is important, however, that no solution that involves the closure of the PATH terminal from the Concourse be considered without evaluation of the effect of that closure on smoke movement in the Concourse. The PATH terminal is a major source of air that avoids a winter condition where the towers could impose a negative force on 4 WTC and 5 WTC.

f. Loading Dock Smoke Control - Damage to the doors between the loading dock and the tower building should be repaired. The rolling steel doors should be equipped with smoke detectors, arranged to close these doors if they should be open and a fire occurs at the dock. Additionally, if two or more smoke detectors in the return air from the B-1 space are activated, the supply to the sub-grade portions of the tower involved and the supply to the lobby of that tower should be shut down. *Roll down fire doors*

were kept closed in winter due to stack effect & double interlocking doors system installed to prevent smoke odors and other odors from being carried due to stack effect up the freight elevators. Penetrations in walls were fire stopped & sealed.

g. Tower Lobby Smoke Control - Damage to the doors between the loading dock and the tower building should be repaired. The rolling steel doors should be equipped with smoke detectors, arranged to close these doors if they should be open and a fire occurs at the dock. Additionally, if two or more smoke detectors in the return air from the B-I space are activated, the supply to the sub-grade portions of the tower involved and the supply to the lobby of that tower should be shut down. *Roll down fire doors were kept closed in winter due to stack effect & double interlocking doors system installed to prevent smoke odors and other odors from being carried due to stack effect up the freight elevators. Penetrations in walls were fire stopped & sealed.*

h. Further Tests - Tests of the proposed procedures should be conducted under both summer and winter extreme conditions prior to implementation of this study to verify the pressures predicted by the model. The procedures recommended above are based on calculations using the model CONTAM96. As such they involve the use of selected field measurements and assumptions relative to specific leakage paths and dimensions. It is felt that pressure differentials and pressures applied to doors in the means of egress are the key measurements. The use of smoke tracers, while not considered essential, could be of assistance in discovering unanticipated leakage paths.

To what extend were these recommends implemented before the events of September 11, 2001 (particularly in regards to automatic activation of smoke control systems)? On page 56 of the "World Trade Center Design Guidelines, Specification and Standard Details Program - HVAC, Fire Protection, and Plumbing (Revised 1998)" [WTCI-128-P] it states the smoke purge operation shall be activated manually by a Fireman's keyed switch. This implies that the 1996 recommendations (listed above) for automatic activation of the smoke control systems were never implemented. Please clarify which smoke control sequences/methods were in place on September 11, 2001. *same as during Hughes study. smoke baffles were added in 5 WTC escalators wells and mall sprinklered but automatic activation of fans based on smoke detectors was not implemented since it was not in accordance with NYC code & was not what FDNY wanted in WTC complex based on discussions with them.*

2. Was the smoke control sequence/operation described in the, "World Trade Center Operation and Maintenance of HVAC System Towers A&B

(1987)" [WTCI-129-P] ever revised/revisited prior to September 11, 2001 or does this document accurately described the smoke control sequence/operation in place on September 11, 2001? If the WTCI-129-P documented has been revised/revisited, where can these revisions be located? *Big Blue remote control to control all fans and smoke purge was installed after 87, unknown if ever written up. I think the contract was WTC 499.18.*

3. To what extent was the smoke purge sequence/functionality tested? What test records exists and where can they be located? *All records were kept at WTC and lost.*

4. Was there any attempt to initiate any type of smoke control on September 11, 2001: *Unknown. Smoke Control would not have been initiated by FDNY typically till the fire was under control or extinguished.*
    a. In Tower 1, subsequent to impact?
    b. In Tower 2, subsequent to impact of Tower 1?
    c. In Tower 2, subsequent to impact of Tower 2?